Identifying Query Images Using Atomic Relation Extraction Method Algorithm

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Abstract- *What we see is what we want - This became easier when Internet took its evolution in the name of Amazon, Flipkart etc. To make this experience even more better and easier, they can use a search engine to find that. When you see any stunning outfits/accessories and you are extremely in need of it, instead of spending hours together in searching of it, you can use Our search engine which is developed based on content based retrieval algorithm to retrieve images automatically with a given input image. The images which are resulted are similar or closest to the signature of the input image. It is not only used to retrieve similar images from an image collection also retrieve descriptive details of a particular content. In the existing system content based retrieval algorithm, that is evaluated by investigating the number of images (from the text database). In our proposed system, images that have the similar visual appearance, it may produce close feature vectors values Atomic Relation Extraction Method Algorithm. Human eyes discriminate images based on their visual content. Simple images, normal methods do not work well for complex scenes but they fail to take back images that match the query only incompletely, that is, only certain regions of the image match. In this paper, we used to retrieve similar images from an image collection. We retrieve image from basis of image content.*

I. INTRODUCTION

Information retrieval is becoming necessary with the massive needs of multimedia data processing to analyze the real-time data. Thus image retrieval is increasingly becoming public and recognized. It is necessary to gadget and improve the tools of image retrieval in order to examine or look images on the internet easily and effectively. The predictable and common image retrieval which is based on keyword search has many problems, such as the high demand of manual work and the dependence on the personal perception which results in incorrect results. To handle the above drawbacks CBIR was applied. This approach involves a set of methods and algorithms that emphases on low level image features, for example texture measurements, shape and color signature to retrieve images from database of images reliant on the query image (QI) given by the user. Existing CBIR systems performance is still disappointing for users of high level concepts as it principally focuses on images' low level visual features and the high level features are not involved in the retrieval process. Therefore two approaches was enhanced to the first is the Region based image retrieval (RBIR) which depends on the depiction of image into segmented regions features based on the image insight by user. The second is the Relevance feedback (RF) which is to ensure the inclination of user. The main goal of the CBIR system is retrieving images that are relative to the QI from the images database. CBIR utilizes the method of "query by example" which retrieves similar images to the input image by a description about the query image inputted by the user, the CBIR system mechanism by query image features extraction, after that the system searches for the features extracted. Feature vector is designed for the extracted features for the QI, CBIR represents every image in the database with a vector, after inputting the query image the CBIR system computes its feature vector then compares it with the vectors stored for every image in the database, the images which have high features similarity to the query image will be retrieved. In order to enhance the image retrieval system performance the Region-based visual signatures was utilized relying on the image segmentation. Based on understanding the tool of optical system of the human, the images must be renowned into properties of region features by the image similarity. These methods compute the segmented region features at the object level and the assessments of the similarity are executed at the region granularity where earlier conservative approaches retrieve and represent images mainly using global features.

II. MATERIALS AND METHODS

2.1 FEATURE EXTRACTION

The CBIR system that this study advises governs the features within the image. This is made possible through the usage of its visual contents including color signature, shape and color texture. Shown in Figure 1 is the block diagram of the projected method. Meanwhile, each process will be detailed in the following sections.

2.2 COLOR FEATURES EXTRACTION

For image retrieval, color feature is a key section. For image databases that are large in size, image retrieval recollecting the color feature is highly active and successful. It should be noted that color feature is not a firm stricture since it is bound to many non-surface features. For instance, the taking conditions including brightness as well as the device's features and the vision point. The steps of the color feature abstraction start with the departure of Color planes values into distinct matrices which are red, green and blue matrices. Then, calculation of color histogram is made for each color matrix for each image.

This is followed by the computation of variance and median of color histogram after which, the computation of the summation of all row variances and medians is performed. Next, the computed features of each matrix (R, G and B) are combined as feature vector (for each image), after generating the feature vectors for all the database images they will be stored in the database of features.

2.3 SHAPE FEATURES EXTRACTION

The primary aim of shape feature extraction is to capture the properties of the shape of the image items. This way, the shape storing, conveying, comparing against, and identifying process can become easy. It is vital that the shape structures are without rotation, translation, and scaling. Further, the abstraction of the images' shape feature requires the bid of median on the gray scale image created from the RGB colored image. This is because median filter only acts on single color rate. The Craig's formula for the conversion of RGB color image to gray scale image is shown below.

$$Igs = [Ir\ Ig\ Ib] * []$$

Where Igs denotes the combined 2D matrix while Ir. Ib. Ig entails the color components that generate the colored image whereas___ is symbolized as the grey level combined image. Meanwhile, salt and pepper noise and speckle noise are reduced using the median filter. Median filter has edge-preserving property and it is employed where blurring of edges is not wanted.

In the context of this study, the canny edge detection method was engaged to abstract shape features. Edge based shape representation was working and this provides a numerical data about image. The provided data remains the same even when there has been modification in size, direction, and position of the objects in the image. When the canny edge detection operator is engaged, histograms of the edge of images are built. Further, design is made for each image column mean and row mean of edge histograms. Then, all column means and row means are computed and kept in the database in the feature vector form.

2.4 COLOR TEXTURE FEATURES

Color texture features classification is a critical step for image segmentation with CBIR. As such, an approach grounded on texture analysis for the ordering of color texture instead of just division is proposed in this study.

2.5 GREY-LEVEL CO-OCCURRENCE MATRIX (GLCM)

The GLCM is a powerful method of image statistical analysis. This method is describable as a matrix of two proportions of joint probabilities between pixels pairs, in which, a distance between them in a given direction. Fourteen features from the GLCM for the classification of texture features were extracted and defined by Haralick. However, since these 14 features are greatly linked, this study prevents this problem by retaining five features to enable comparison. The steps of the color texture features extraction start with the filtering of the input image utilizing the 5×5 Gaussian Filter. Then, the filtered image is split into 4×4 blocks. Using GLCM, Standard Deviation, Correlation, Homogeneity, Entropy, Average, Contrast Dissimilarity and Energy for every block are computed. The computation of these features were according to four directions; diagonally (45deg135deg), vertically (0deg) and horizontally (90deg). Finally, these extracted structures are saved in the database of feature. Table 1 shows the GLCM features.

PROPOSED META-HEURISTIC ALGORITHM

The proposed meta-heuristic algorithm (genetic algorithm and Iterated local search) was originally used to create chromosomes. Here, the genetic factor found within the chromosomes mean the images of the database. It is vital that the chromosome has no repetitive genes.

Meanwhile, the values of the genes are said by the amount of database images that will be requested. The features that are mined from each image are gathered as a feature set. Extraction is also performed on the set of features from the query image. Each of the chromosomes is then subjected to the crossover, mutation (genetic operators) and Iterated local search procedures. This will produce new chromosome. As for the parameter settings of the proposed MA, they were experimentally determined. Pseudo code of the proposed MA is shown in Figure 2.

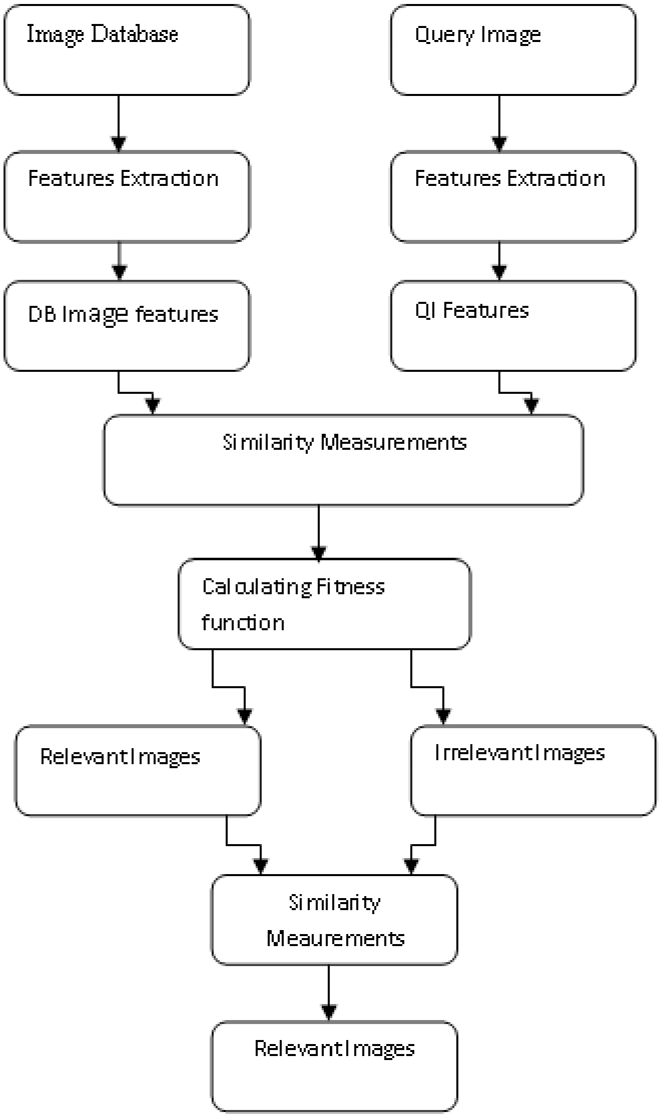


Table 1:

Name	Formula	Name	Formula
Average	$\mu i = \sum_{i,j=0}^{N-1} i(P_{i,j}) \mu j = \sum_{i,j=0}^{N-1} j(P_{i,j})$	Contrast	$\sum_{i,j=0}^{N-1} p_{i,j}(i-j)^2$
Standard Deviation	$\sigma i = \sqrt{\sigma_i^2} \sigma_j = \sqrt{\sigma_j^2}$	Dissimilarity	$\sum_{i,j=0}^{N-1} P_{i,j} \lvert i-j \rvert$
Correlation	$\sum_{i,j=0}^{N-1} \frac{(i-\mu_i)(i-\mu_j)p(i,j)}{\sigma_i \sigma_j}$	Homogeneity	$\sum_{i,j=0}^{N-1} \frac{P_{i,j}}{1+(i-j)^2}$
Entropy	$\sum_{i,j} P(i,j) log P(i,j)$	Energy	$\sqrt{\sum_{i,j=0}^{N-1} P_{i,j^2}}$


```
Meta-heuristic Algorithm
Set the GA parameters
Set the ILS parameters
begin
:=generate initial solutions (population);
repeat
For offspring creation two parents will be selected
Employ replica operators( crossover and mutation)`
Enhance offspring via ILS algorithm
Population<-new version (population)
untilTermination Criterion is met
end;
end;
```

Figure 2: MA Pseudo code

SOLUTION REPRESENTATION

The meta-heuristic algorithm (GA and ILS) that this study proposes services a direct depiction for every candidate solution (chromosomes) in the population. This consists of data on the amount of images in the database and the amount of equals in a form of binary.

3.2 THE INITIAL POPULATION

A number of chromosomes are produced arbitrarily at first. The number of chromosomes is called population size or *pop size*. The quantity of required images that are linked to the input query image will order the number of genes in every chromosome. The production of chromosome is illustrated in Figure 3.

The GA is usually started via the calculation of fitness of each candidate solution in the initial population. Although the stopping criterion is not satisfied, these processes are used: (i) The selection of a solution for reproduction by way of certain collection mechanisms (*e.g.* roulette wheel). (ii) The construction of offspring by way of crossover and mutation operators.

3.3 CROSSOVER OPERATION

Crossover is the key operator within the algorithm. As explained by, using single cut point, crossover produces a new group (chromosomes) from two parents. This operation controls single crossover point on both parent chromosomes designated. Here, a random number between 1 and 1c-1 is chosen and 1c denotes the chromosome length. The parent chromosomes are changed at the crossover's chosen point. Then, after that point, the modules are exchanged between the parent chromosomes.

3.4 MUTATION OPERATION

The mutation operator produces random changes in solutions. This offers an opportunity for lost keys from the population. The operation of alteration employs the method of bit-by-bit. The implementation of mutation operator will take place if the ratio of mutation (Pm) is verified. In the context of this study, Pm is equivalent to 0.03 and the point that will be mutated is chosen randomly.

3.5 Iterated local search (ILS)

A local search algorithm is used preceding to moving to the next generation. This will improve solution (chromosome) resultant from the genetic algorithm following the act of genetic operators. This process increases the speed of the genetic algorithm's conjunction. The resulted solution from the local search is then injected back into the genetic procedure for the ensuing generation. The process will then arise to the next generation and keep posted the population of chromosomes.

```
ILS Procedure
begin
s0 = Generate initial solution
Employ a local search procedure to s0 and get s
Repeat
Employ perturbation to s and get s'
Employ local search method to s' and get s''
If f(s'')> f(s);
s_ s''
untilTermination Criterion is met
returns;
```

The basic idea of Iterated local search is to progress the procedure of local search through giving a new solution to start with, these solutions are obtained from the disturbed existing solutions until reaching a local optimal answer. The created solutions are better-quality than the solution from the monotonous local search trials. If the receipt measure is passed, it is considered as the new solution. If not passes the principle, the previous solution is returned. The agitations should be robust enough to allow discovering new solutions, on the other hand satisfactorily weak to keep the good information added in the previous search. A generic Iterated local search for a maximization problem is shown in Figure 4.

As for the algorithm projected in this study, it always accepts solutions with higher strength values. Meanwhile, solutions with fitness values equivalent to the best solution's fitness value are accepted provided that that the values contain a smaller amount of matching features. The process will result until the maximum amount of iterations (#Iter is set to 10000) is attained.

3.6 FITNESS FUNCTION

With a selected fitness function, the algorithm assess every candidate solution from the whole population. The fitness function gives sign on the reliability of a candidate solution. The performance of algorithm and the solution of the optimization problem are majorly dictate by the fitness task.

As such, in the design phase of algorithm, the way of choosing a fitness function is highly vital.

Determining the fitness value (quality) using the Squared Euclidean Distance for each newly fashioned chromosome is the next step. Fitness is dictated by the match between the image to be queried and the feature sets of the newly produced chromosomes. The chromosome with the minimum similarity difference in comparison with the input query image is considered the best chromosome. Images most relevant to the input query image are genes of the optimal obtained chromosome. The equation of the Squared Euclidean Distance is shown below (equation 2).

$$\text{Squared Euclidean Distance} = \text{sum}(f(l)-f(l) \le 0.0009$$

In the algorithm proposed in this study, the similarity of the two images is assessed as the difference between the total of query image features and total database image features. It is important that the difference is lower than or equal to 0.009 (for instance, Squared Euclidean Distance <=0.009) or the two images cannot be regarded as similar. The determination of the Squared Euclidean Distance of the fitness function proposed was experimentally done.

3.7 SELECTION OF CHROMOSOMES

Selection entails the process that provides control to the algorithm towards an optimal solution by inclining towards chromosomes with high fitness. For the same purpose, this study employs a roulette wheel to select the device of best retrieved images from the database according to the number of features matches. The process is done over and over until the maximum number of iterations is achieved. Then, the best chromosomes with the highest fitness number are selected from the set of chromosomes gathered before

These finest chromosomes were used in the recovery of the related images from the database of image. As such, the similar images that will be effectively retrieved comprise those containing indices represented with the genes of the best chromosomes.

IV. IMAGE DATASET

The experiments in this study employed the Corel dataset which contains 10,908 different images with each image in the size of 256*384 or 384*256. As such, the outcomes were reported using the ten semantic sets with every comprising of 100 images. These datasets are in the groups of Food, Buses, Elephants, Mountains, Beach, Buildings, Flowers, Africa, Horses and Dinosaurs. These groups were used in reporting the results owing to the fact that the majority of the outstanding researches, for instance employed these groups in demonstrating the effectiveness of their methods of CBIR.

V. RESULTS AND DISCUSSION

The CBIR system that this study proposed undergo test with some amount of query images. Further, retrieval was made to the similar images from the coral image database. For this purpose, removal was made to the features including color histogram, shape and color texture from all images found in the database. Shown in Figure 5 is the Dress image in different forms using median filter and edge detected image using the canny algorithm.

Query Image Resultant images

Color signature was working in this study in the calculation of features of color histogram with reverence to Variance and median. The shape features were calculated using the canny edge detection method while color texture was engaged in the calculation of the features of GLCM with respect to standard deviation, entropy, average, correlation, dissimilarity, homogeneity as well energy. The features extracted from color signature, shape and color texture were all classified and combined in the generated feature set. Then, following the extraction of feature set from the database images, assessment was made between the feature set and that of the input query image. Here, the GA was employed in the retrieval of the similar images from the images kept in the database. Following the completion of the feature extraction process, similarity was measured using MA.

The GA produces random chromosomes (*pop_size*) with a length. Meanwhile, the amount of required images linked to the query image will dictate the amount of genes in every chromosome. The feature extraction is performed for the generated chromosomes as well as for the query image. Then, the chromosomes undergo the process of mutation and crossover and ILS and selection mechanism for ruling the optimum chromosome. After the completion of crossover, mutation and Iterated local search operations, collection is made to the chromosomes with the best values. The chosen chromosomes create the indices of the images related to the query image. Repetition is made to this procedure until the maximum amount of iteration siter(max)=1000 is achieved.

5.1 Evaluation of the Retrieval (Precision/Recall)

Precision refers to a measure of the ability of the system in retrieving just the images that are similar to the query image. Meanwhile, the Recall rate called the positive rate or sensitivity, gauges the capacity of CBIR systems in retrieving the image that are similar to the Qis. For the elaboration of the results, computation was made to precision and recall according to the number of query images (from the test dataset) and the retrieved similar images from the corel image database.

$$Recall = \frac{\text{Number of similar images retrieved}}{\text{Total number of images in the database}} \quad (3)$$

$$Precision = \frac{\text{Number of similar images retrieved}}{\text{Total number of images retrieved}} \quad (4)$$

Equations 3 and 4 comprise the calculation of the precision and recall for the query image. The recall- precision calculated for some query image and their retrieved images are presented in Table 2. Meanwhile, the graph of the exact precision-recall of the CBIR system proposed in this study is presented in Figure 8. As evidenced by the graph, the CBIR system projected in this study has high level of efficiency aside from having the strength to retrieve the images. Experimentally, when more alike images are retrieved, the precision and recall will be better. The reported results by means of the extracted features united with the techniques of MA show very promising improvements with respect to the efficiency and accuracy of the overall CBIR process.

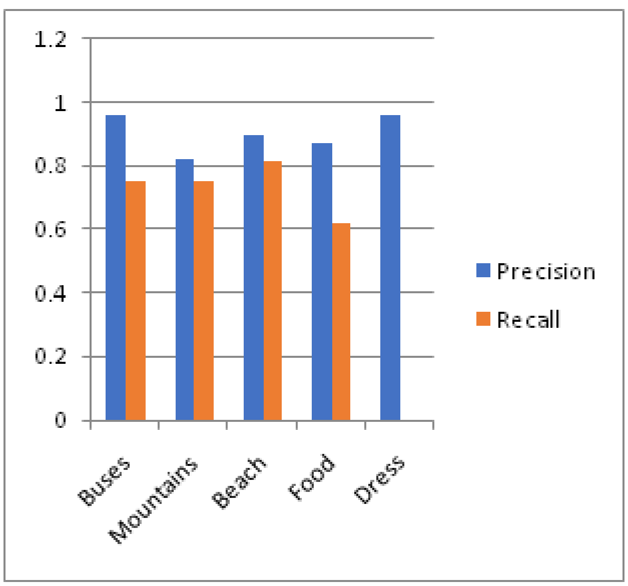
5.2 Evaluation on Corel Image Set

Comparisons were made between the CBIR system planned in this study and a number of present CBIR systems. This allows the dimension of the usability of the proposed method. The motivation for this selection to compare with these methods is that the results of these methods were reported via a common denomination of ten semantic sets where an individual set contains 100 images of Corel dataset.

As such, it is possible to compare clear results using the reported results. This makes the performance comparison possible. The comparison of the average precision for every group of the proposed system with other comparative systems can be referred in Table 3. As evidenced by the results, the proposed system demonstrates sounder performance with respect to precision in comparison to other systems. Comparison of the average recall rates for all groups of the proposed system with the same comparative systems is shown in Table 4.

Table 2: Recall-Precision Measurements

Groups	Precision	Recall
Buses	0.96	0.75
Mountains	0.82	0.75
Beach	0.90	0.815
Food	0.87	0.62
Dress	0.96	0.66



Precision and Recall Graph.

Table 3: Average Precision Results of the proposed method compared with the standard retrieval method.

Class	Proposed method	[1]	[1]
Buses	0.96	0.846	0.95
Mountaims	0.82	0.811	0.75
Beach	0.90	0.892	0.70
Food	0.87	0.871	0.75
Dress	0.96	0.915	0.95
Average	0.883	0.830	0.820

Table 4: Average recall Results of the proposed method compared with the other standard retrieval methods.

Class	Proposed method	[1]	[2]
Buses	0.75	0.733	0.19
Mountaims	0.75	0.732	0.15
Beach	0.815	0.805	0.14
Food	0.62	0.533	0.15
Dress	0.66	0.64	0.19
Average	0.7125	0.69	0.164

As can be deduced, the above comparison results show the ability of the planned system in generating better precision and recall rates. Its performance also supersedes other state-of-the-art methods particularly with respect to precision and recall rates. In specific, the average precision and recall rates obtained were **0.8883** and ***0.7125*** in that order. This is factored by the fact that the authors in formed the systems of CBIR that extract a limited number of feature sets. This restricts retrieval in terms of efficiency. On the other hand, the system proposed in this study extracted robust and extensive set of features. In this system, color signature using the technique of color histogram, shape features using the canny edge detection method and color texture using the GLCM, are employed. Also, the meta-heuristic techniques were employed for optimizing the precision of the retrieved images. The addition of the ILS algorithm with the GA has raised the quality of solution (weight) via the increase of the fitness number. This has helped in the development of the exploitation process when the thorough process is being conducted. Clearly, the experimental outcomes are demonstrating the capacity of the meta-heuristic techniques in assisting the retrieval of the great amount of the relevant images to the query image.

VI. CONCLUSION

This study recommended the effective CBIR system employing MA for the retrieval of images from databases. Once a query image is entered, the proposed CBIR performs the extraction on the image features such as color signature, shape and texture color from the image. Meanwhile, the MA based similarity measure is used to efficiently retrieve images relevant to the query image. The experiments were conducted according to the Corel image database. As shown, the proposed MA algorithm possesses strong capacity in distinguishing color, shape and color texture features. The addition of the ILS algorithm with the GA has raised the quality of solution (weight) via the increase in the fitness number. This has assisted in the improvement of the exploitation process during the process of searching. The CBIR system proposed in this study was assessed via different images query. As demonstrated by the implementation results, the method is winning in retrieving the similar images from the images database. It also supersedes other proposed CBIR systems with respect to average precision and recall rates. This can be evidenced from the precision and recall values that were computed from the results of retrieval. In exacting, the average precision and recall rates were **0.8883** and **0.772 like**wise. For the approaching work, the techniques of filtering will be utilized in order to attain results that are more accurate in the content based image retrieval system.

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